MONTANA STATE AVIATION SYSTEM PLAN 1995 UPDATE

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prepared for

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CHAPTER 1 INTRODUCTION

The 1995 Update to the Montana State Aviation System Plan (Phase VII) looks at two new areas of airport planning. The Standards Review (STAR) and the Airport Information Management System (AIMS) are planning tools usable by the general aviation airports across Montana. They become part of the Montana Aviation System Plan which is an ongoing effort to evaluate and prioritize system effectiveness and need.

The Montana Aeronautics Division (MAD) of the Montana Department of Transportation (MDOT), in coordination with the Federal Aviation Administration (FAA), Helena Airports District Office, contracted with Robert Peccia and Associates (RPA) to provide the review and analysis required to complete these investigations.

A contract was executed on July 27, 1995. This contract was separated into two main tasks. The first task consisted of a Standards Review (STAR) of 53 airports having a total of 65 paved runways. The second task, Airport Information Management Systems (AIMS), included evaluation, review and recommendations of computer and software systems used by the MDOT Aeronautics Division. This report deals only with the Standards Review portion of the contract. The AIMS portion of the contract has been completed as a separate report.

The Standards Review work, as defined by the contract, generally included:

- ✈ Determination of the Current Airport Reference Code
- ✈ Runway Inventory
- ✈ Runway End Inventory
- ✈ Taxiway Inventory
- ✈ Lighting Inventory
- ✈ Determination of Deficiencies
- ✈ Documentation of Results

The information obtained from these tasks has been compiled and summarized on the following pages. Figure 1 shows the airports throughout Montana which were evaluated at MAD's direction, indicated in bold typeface. The other airports shown on the Figure are in the National Plan of Integrated Airport Systems (NPIAS) for Montana. Those having a star marking their location are the seven commercial service airports in the State of Montana.

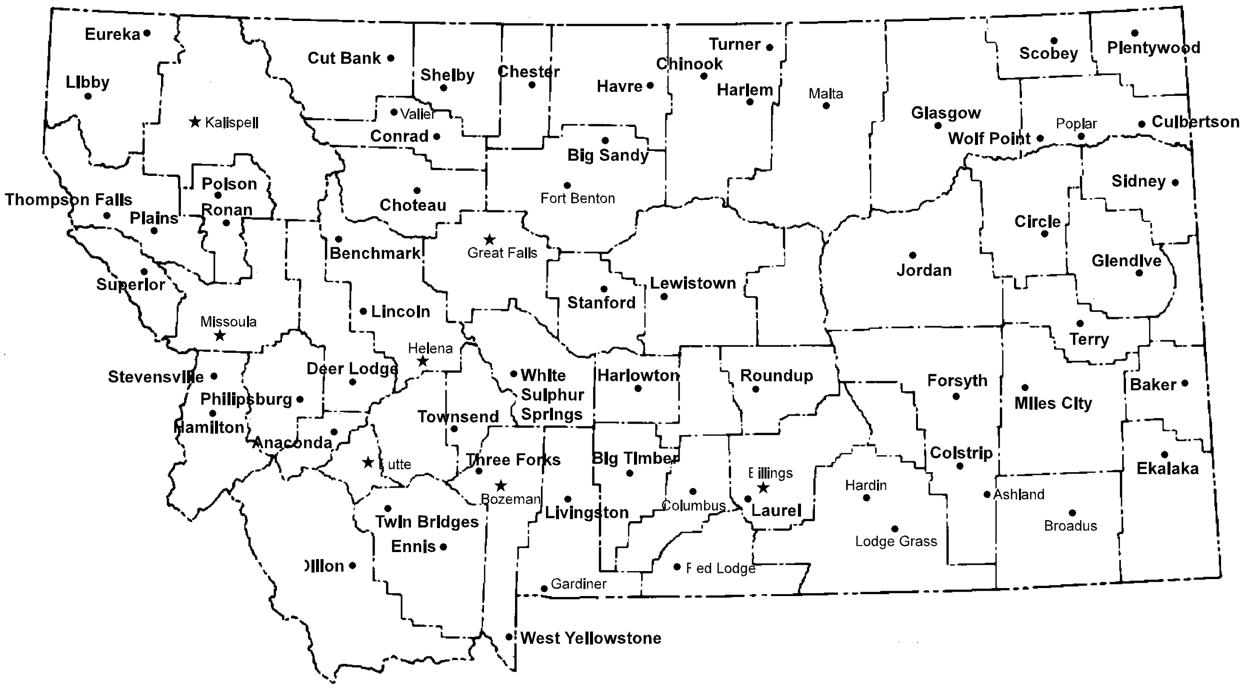

Figure 3 - MONTANA AIRPORTS EVALUATED

1.1 DEFINITION OF TERMS AND ACRONYMS

As is the case with most fields of interest; airports, flying, and airport design have some unique terms and acronyms which people unfamiliar with the subject may not recognize or understand. These terms and acronyms are sometimes misused and misunderstood. For purposes of clarification, some common aviation terms and acronyms are defined in this section.

Our reference sources for this section include the U.S. Department of Transportation - Federal Aviation Administration's - *Federal Aviation Regulations - Part 77 - Objects Affecting Navigable Airspace*, and *Airport Design Advisory Circular 150/5300-13 Change 4*."

These references as well as the following information sources, were used in completing this report: *Montana State Aviation System Plan - 1994 Update (Pavement Condition Survey)*, *National Plan of Integrated Airport Systems Update and Montana State System Plan Update - 1990*, U.S. Department of Commerce - National Oceanic and Atmospheric Administration (NOAA) - Airport Obstruction Charts, *U.S. Terminal Procedures* dated September 1995, and the *Montana Department of Transportation - Aeronautics Division 1995 Airport Directory*.

AVIATION TERMS AND ACRONYMS

AC	Advisory Circular	FAA publications that outline their requirements or guidelines on a wide range of various topics.
	Aircraft Approach Category	A grouping of aircraft based on 1.3 times their stall speed in their landing configuration at their maximum certificated landing weight. The categories are as follows: Category A: Speed less than 91 knots. Category B: Speed 91 knots or more but less than 121 knots. Category C: Speed 121 knots or more but less than 141 knots. Category D: Speed 141 knots or more but less than 166 knots. Category E: Speed 166 knots or more.
ADG	Airplane Design Group	A grouping of airplanes based on wingspan. The groups are as follows: Group I: Up to but not including 49 feet. Group II: 49 feet up to but not including 79 feet. Group III: 79 feet up to but not including 118 feet. Group IV: 118 feet up to but not including 171 feet. Group V: 171 feet up to but not including 214 feet. Group VI: 214 feet up to but not including 262 feet.
	Airport Elevation	The highest point on an airport's usable runway expressed in feet above mean sea level (MSL).
AIP	Airport Improvement Program	Federal Government program which provides aid to NPIAS airports for various construction projects, equipment and land acquisition as well as professional services.
ALP	Airport Layout Plan	The scaled drawing of existing and proposed land and facilities necessary for the operation and development of an airport. All airport development carried out at Federally obligated airports must be done in accordance with an FAA-approved ALP. The ALP, to the extent practicable, should conform to the FAA airport design standards existing at the time of its approval.

AOC	<u>Airport Obstruction Chart</u>	Published by NOAA. (See OC)
ARC	<u>Airport Reference Code</u>	The ARC is a coding system used to relate airport design criteria to the operational and physical characteristics of the airplanes intended to operate at the airport. The first component is the Aircraft Approach Category (A - E) and the second component is the Airplane Design Group (I - IV). It should be further specified as either visual, non-precision, or precision approach capable based on the approach visibility minimums.
ARP	<u>Airport Reference Point</u>	The latitude and longitude of the approximate center of the airport based on the weighted average of the ultimate paved runway centroid(s).
BRL	<u>Building Restriction Line</u>	A line which identifies suitable building area locations on airports. It is a closed perimeter line encompassing the RPZs, runway OFA(s), runway visibility zone, NAVAID critical areas, and areas required for terminal instrument procedures and tower clear line of sight.
EL	<u>Elevation</u>	Vertical position of a point in space relative to a datum - usually mean sea level (MSL).
FAA	<u>Federal Aviation Administration</u>	
FBO	<u>Fixed Based Operator</u>	A person or company that provides an aviation related business to the flying community of an airport that is usually airplane specific, ie. aviation gas, maintenance repairs, flight instruction, etc...
IFR	<u>Instrument Flight Rules</u>	Rules that apply to pilots when visibility conditions become deteriorated enough to warrant the ability of the aircraft pilot to fly, navigate, take-off and land solely by the use of instruments. A pilot must be IFR certified to fly under these conditions as outlined by FAA established criteria.
ILS	<u>Instrument Landing System</u>	A NAVAID that provides electrical signals enabling a pilot to land an aircraft with the use of instruments if so equipped and trained.

	Large Airplane	An airplane of more than 12,500 pounds maximum certificated takeoff weight.
	Master Plan	A document produced by a knowledgeable entity that outlines the expected future of an airport site or potential site, and serves as a guide for developments over approximately 20 years to satisfy aviation demands and maintain aviation standards.
NAVAID	Navigational Aid	Electrical and visual air navigational aids such as lighting, signs, glide slope indicators, and aircraft positioning systems.
NOAA	National Oceanic and Atmospheric Administration	
NPI	Non-Precision Approach	An approach to an airport for landing an aircraft with the use of instruments in order to get within three fourths of a statute mile before being able to use visual flight rules to land.
OC	Airport Obstruction Chart	A drawing with information sheets produced by NOAA that depict any obstruction and runway data for an airport. Information is obtained using field survey and photogrammetric methods and compared to FAR - Part 77, "Objects Affecting Navigable Airspace." Oftentimes this information is relatively old, but provides accurate data on long standing obstructions for airports with OCs.
OFA	Object Free Area	An area on the ground centered on a runway, taxiway, or taxilane centerline provided to enhance the safety of aircraft operations by having the area free of objects, except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.
OFZ	Obstacle Free Zone	The OFZ is the airspace below 150 feet above the established airport elevation and along the runway and extended runway centerline that is required to be clear of all objects, except for frangible visual NAVAIDs that need to be located in the OFZ because of their function, in order to provide clearance protection for aircraft landing or taking off from the runway, and for missed approaches.

PART 77 SURFACES

Primary Surface	A surface longitudinally centered on a runway - extending 200 feet beyond each end of the runway. The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline. The width varies depending on the pavement strength rating and approach visibility minimums.
Horizontal Surface	A horizontal plane 150 feet above the established airport elevation. The perimeter is established by swinging arcs of 5,000 feet or 10,000 feet, depending on the pavement strength rating and approach visibility minimums, from the end of each primary surface. These arcs are then connected by tangents to complete the perimeter.
Transitional Surfaces	Surfaces extending outward and upward at right angles to the runway centerline at a slope of 7 to 1 from the sides of the primary surface and approach surfaces to the horizontal surface.
Approach Surfaces	A surface longitudinally centered on the extended runway centerline and extending outward and upward from each end of the primary surface. The dimensions and slope of the surface depends on pavement strength rating and approach visibility minimums.
Conical Surface	A surface extending outward and upward from the periphery of the horizontal surface at a slope of 20 to 1 for a horizontal distance of 4,000 feet.
PAPI Precision Approach Path Indicator	Lighting equipment consisting of two or four side-by-side boxes that project red and white beams of light at different angles toward approaching aircraft. When the pilot maintains a descending slope with both red and white light visible, he is on the recommended glide path provided the indicators are correctly calibrated.

	Precision Approach	A runway with an instrument approach procedure which provides for approaches to a decision height (DH) of not less than 200 feet and visibility of not less than 1/2 mile or Runway Visual Range (RVR) 2400 (RVR 1800 with operative touchdown zone and runway centerline lights.)
RPZ	Runway Protection Zone	An area off the runway end to enhance the protection of people and property on the ground.
RSA	Runway Safety Area	A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway.
RW	Runway	A defined rectangular surface on an airport prepared or suitable for the landing or takeoff of airplanes.
	Small Airplane	An airplane of 12,500 pounds or less maximum certificated takeoff weight.
TL	Taxilane	The portion of the aircraft parking area used for access between taxiways and aircraft parking positions.
TSA	Taxiway Safety Area	A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway.
TW	Taxiway	A defined path established for the taxiing of aircraft from one part of an airport to another.
TH	Threshold	The beginning of that portion of the runway available for landing. When the threshold is located at a point other than at the beginning of the pavement, it is referred to as either a displaced or a relocated threshold depending on how the pavement behind the threshold may be used.
	Displaced Threshold	The portion of pavement behind a displaced threshold may be available for takeoffs in either direction and landings from the opposite direction.

Relocated Threshold	The portion of pavement behind a relocated threshold is not available for takeoff or landing. It may be available for taxiing of aircraft.
USGS United States Geological Survey	A portion of the U.S. government that is associated with geological information and services. They produce quadrangle maps (detailed maps with elevation information for relatively small areas), which are useful in airport evaluation and design.
VASI Visual Approach Path Indicator	A device similar to a PAPI in function except that the instruments are staggered longitudinally along the runway rather than side-by-side.
Visual Approach	An approach to an airport for landing an aircraft that does not require the use of IFR instrumentation to land in poor visibility.
Visual Runway	A runway without an existing or planned straight-in instrument approach procedure.
VFR Visual Flight Rules	Rules that apply to pilots when visibility conditions do not restrict a pilot based on their ability to fly under IFR.

1.2 GENERAL AIRPORT INFORMATION

Table 1 is a compilation of the evaluated airports, the various numbers and codes associated with each, and some general airport information that can be found in the Montana Airport Directory.

The associated city and airport name have been shown because typically people associate an airport with the nearest city rather than by a name with which they may not be familiar. This is consistent with most publication formats.

Paved runways at each location have been indicated. No turf runways were included in the review. Where an Airport Obstruction Chart (OC) is available for the airport, it is noted.

Included in the table is the most recent information available on the current Owner, Manager and contact person's telephone number.

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WORKSHEET A

1.3 AIRPORT LAYOUT PLAN INFORMATION

Information typically found on an airport layout plan for each of the general aviation airports investigated is shown in Table 2.

The latest revision of the Airport Layout Plan (ALP) that could be found on file with the FAA for each airport was used in the creation of this report. The date of the ALP or its latest revision has been shown. The FAA provided an ALP list with dates on which they were approved. These dates have been shown to document the version that was used. Two of the airports are known to have ALPs currently undergoing modifications by their airport engineer as a result of recent or current construction projects. Their ALP dates have been projected and the FAA date left blank.

The Airport Reference Code (ARC) used in the evaluation of each airport is explained in greater detail in *Section 1.1* and *Section 2.2*. The establishment of each ARC is the basis for evaluating compliance with FAA standards.

Latitude and longitude of each airport's Airport Reference Point (ARP) is included for the ability to compare the ALP's coordinates with other publications such as the Montana Airport Directory. In some cases, these values may have changed as a result of improvements or changes in thinking about the airport's future improvements. In a few cases, the coordinates were not available from the ALP and the Directory values were used. Most ALPs did not indicate whether the values were 1927 or 1983 North American Datum (NAD) based. Since only the more recent ALP versions indicate the newer datum is being used, the majority of the older ALPs are assumed to be using the older datum. This report does not attempt to differentiate between the two datums.

Airport elevation and mean maximum daily temperature have also been included in the table since they are used to determine the airport's satisfaction of recommended runway length.

Also included are navigational aids associated with each airport. These are helpful in determining the type of pavement marking that should be applied on each runway.

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1.4 RUNWAY DATA

Table 3 contains specific data for each runway of each airport included in this review. Of the 53 airports investigated, only one has three paved runways in use - Lewistown Municipal Airport. The majority of the airports (32) have only one paved runway. The remaining ten airports have two paved runways each, for a total to 65 paved runways included in the Standards Review.

The first column of data lists the runway's orientation. Those highlighted by an asterisk have been recently changed due to drift in the earth's magnetic declination, or there are conflicts between the airport's ALP and other publications. The correct/actual runway markings have been shown in this table. No attempt was made to evaluate each airport for the correct markings relative to their bearing, but the airports noted had obvious changes or conflicts.

The Airport Reference Code (ARC) column shown is the same as the one referred to in Table 2-Airport Layout Plan Information, except the Code is specific to the individual runway. In Table 2, only the highest rated Code for the airport is used to rate the airport if there is more than one runway.

The pavement's ability to carry load (less than 12,500 pound load = "small", or greater than 12,500 pound load = "large"), and the Approach Category as it relates to ability to navigate a landing based on instruments, play a part in determining the various runway requirements evaluated in this project. The standards primarily affected by these characteristics are the dimensional criteria recommended by FAR - Part 77.

Runway grade, length and width are the other dimensional criteria presented here for comparisons. Runway surface was included to determine whether there were any other paved surfaces such as concrete being used as a finished runway pavement section.

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CHAPTER 2
PROJECT APPROACH

CHAPTER 2 PROJECT APPROACH

2.1 IDENTIFICATION OF TASKS

The first step in determining the items or tasks involved for this project was the negotiation of a contract and identification of airports in the State to be evaluated. The contract states that under this project the existing airport's runway(s), taxiway(s) and associated fixtures would be evaluated against the major airport dimensions recommended by AC 150/5300-13 CHG 4, and FAR - Part 77.

An activity list of items that would have to be completed in order to satisfy the project requirements became part of the contract. Dependency of each item relative to the others was established and a precedence network was drawn to show which items could be completed in parallel with others. A simplified version of that critical path network is shown as Figure 2 to illustrate the major tasks, and their role in completion of the contract requirements.

A double line marks the path of activities that were most critical to completing the project in a timely manner. As one would imagine this critical path of activities includes the initial gathering of information, the formulation of a plan and method of data gathering, and the actual visits to each airport.

Clarification of several items was made during the course of this investigation. First, only existing conditions at the airports would be evaluated. The complexity involved in including projections, evaluations and research of each airport's future conditions was considered to be too high. That scope of work would approach the same amount of effort required to complete an ALP for each airport. For this reason, only items that could be checked with simple devices were included in the evaluation for this project (ie. no surveying or electronic distance measurements).

Several items usually noted on ALPs were excluded from this study. These included the location of roads and fences on the airport, unless they were infringements or in the RPZ. Also, when roads were in the RPZ they were noted on the drawings, but not evaluated in the field. The reason for this was that clearance requirements above the road need to be determined by precise surveying measurements.

Another factor excluded from this study was land use ownership or control for the recommended RPZ on each runway end. Evaluation of this subject would have required considerable additional field work and research of legal records.

Also not included were apron dimension requirements such as tie-down separation and spacing, taxilanes, and turf landing strips or taxiways because of their abstract and oftentimes unauthorized nature. Only hard surfaces were involved in this review.

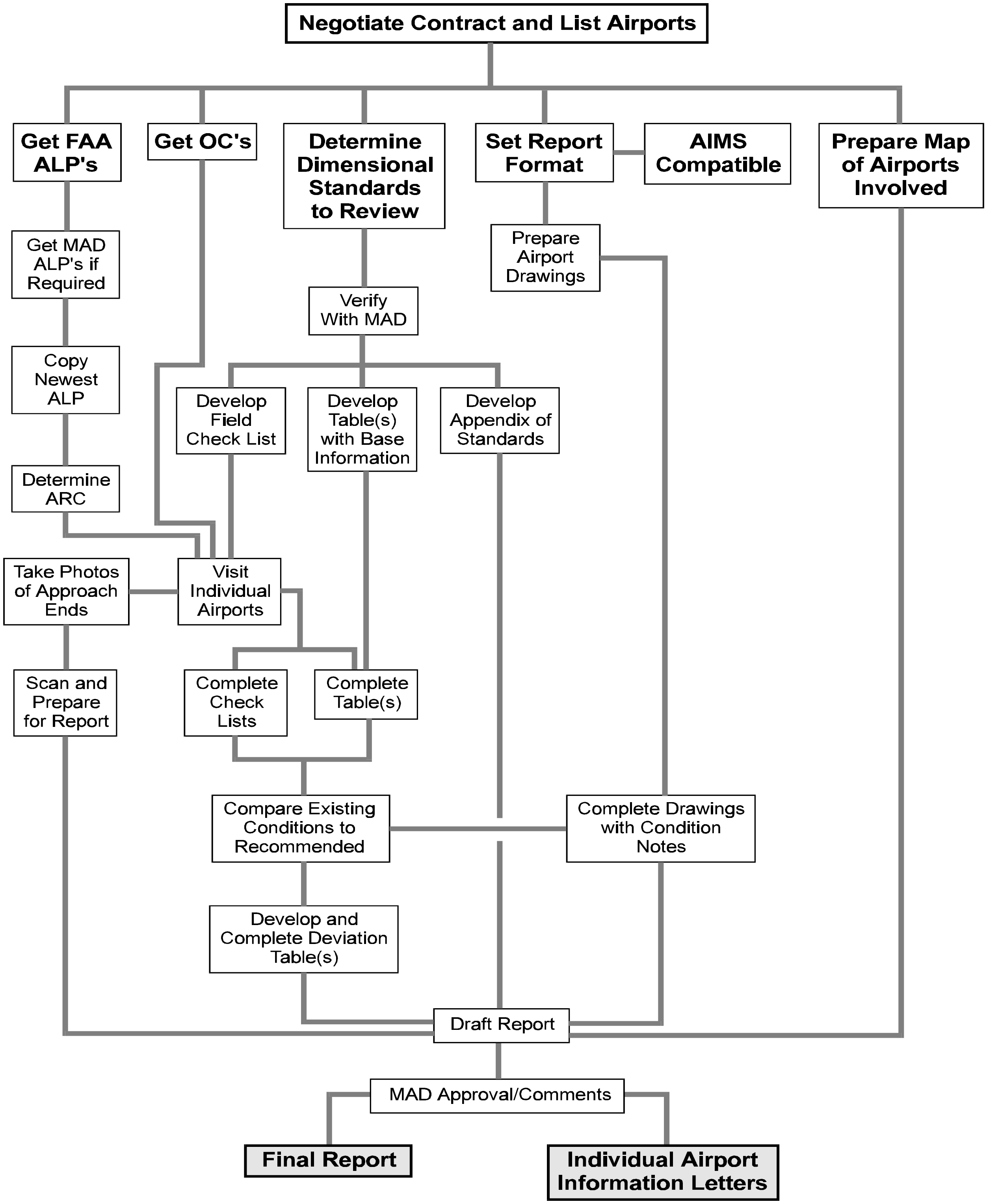

Figure 4- STANDARDS REVIEW TASK FLOW CHART

Actual items evaluated at each site visit can be seen on the blank checklists included in *Appendix 2*. Every ARC has a unique checklist that identifies the criteria specific to that code. These values come from the FAA's AC 150/5300-13 CHG4 and FAR - Part 77.

2.2 DETERMINING AIRPORT REFERENCE CODES

Airports with recently completed Airport Layout Plans (ALP), generally include Airport Reference Code (ARC) information. In these cases, the ARC was taken as indicated and no further investigation was done to determine the accuracy.

Most airports with older ALPs (pre-1990) did not include this ARC information or used nomenclature from the FAA's previous method of classifying airports (ie. Basic Utility or General Utility). In these cases, a dimension or feature on the drawing, such as a runway safety area, that did not change in recommended size due to a change in classification methods was used to classify the ARC under the new system.

Since Montana has many single paved runway airports, it was not uncommon to encounter airports of a certain category with runway widths in excess of what is required. This is an apparent attempt to provide greater safety during cross-wind conditions with only one runway.

Per the FAA's direction, no airport was classified lower than approach category B. Therefore, the least demanding criteria to be compared to existing conditions was a B-I small category.

Pavement strength was almost always identified on the ALP drawings. It was used to determine whether the airport could handle large or only small aircraft. (See *Chapter 4* for a discussion on large aircraft and related runway length.)

Any airport runway with a "procedure" in NOAA's U.S. Terminal Procedures manual was classified as having a Non-Precision Instrument (NPI) approach. This is because they indicated visibility minimums of three quarters of a statute mile or greater. By definition these are NPI runways. The only exception was West Yellowstone Airport which had visibility minimums of one half of a statute mile.

The Approach Category, Design Group, Pavement Strength, and Approach Type mentioned above had to be determined for each airport prior to inspection of that airport. These categories determine which criteria were to be used for evaluation of existing features.

2.3 DATA COLLECTION

2.3.1 Equipment

The Montana Aeronautics Division (MAD) identified which items required field identification, and the method of gathering data had to be simplified to reduce costs. Only those items measurable with walking wheels, measuring tapes, hand levels, and an inclinometer were evaluated.

A simple paper device was manufactured to visually check the outer limits of the approach slope from a point on the runway. This was a basic device to aid the evaluator in determining how far to each side the approach slope should be checked. Since the method did not lend itself to high precision, items that were marginally on the approach slope fringes were so noted.

An inclinometer was used to measure the percent of slope of an object relative to a horizontal plane. This instrument was employed to evaluate the adequacy of the approach slope and whether or not there were transitional surface penetrations. This device can be read to approximately one-half degree accuracy - or within one foot of elevation for every two hundred feet of distance from the observer. One problem encountered during the site investigations was that cold temperatures (-40°F plus windchill) tended to make the instrument's liquid filling very viscous. There were some instances where less accurate readings resulted from the atmospheric conditions. Every effort was made to minimize this risk.

Another component that was affected by climatic conditions was the use of a walking wheel. This device under normal conditions is adequate for measuring distances from existing features. However, during the field evaluations conditions ranged from dry ground to mud and wide range of snow cover conditions. Again, steps were taken to minimize the loss of accuracy due to the adverse effects of ground conditions on the walking wheel. In some instances, distances were measured two or more times.

2.3.2 Exceptions

One element that could not be readily measured was the portion of the transitional surface that is triangular shaped and adjacent to the approach slope. Since this surface transitions from an inclined plane to the horizontal surface, it is relatively complex to locate with hand operated tools. For this reason, this area was evaluated by estimation and objects with even a remote possibility of being a penetration were noted.

Items that were obviously in compliance were not measured, but were noted on the form as being acceptable. For example, a fence line 600 feet from a small airport's runway end and clearly below the runway elevation; or a runway approach with falling or level terrain into the far horizon would not actually be checked for compliance.

2.3.3 Quandaries

Two issues which came to light during the field data collection portion of this project resulted in re-examination of FAA literature due to conflicts between similar airports. The first issue was relatively minor and has been resolved as described below. The second issue remains unresolved even with FAA involvement.

While measuring the distance from runway centerlines to hold lines on taxiways and turn-around bays, it became apparent that there are different designs being used for the hold line placement. In some cases, the lines were in outright non-compliance. In other cases, they were farther back than necessary - usually in accordance with the anticipated future ARC.

When the hold lines were near the compliance distance, some were placed according to the far side (farthest from the RW centerline) of the line and others according to the near side (closest to RW centerline) of the line. A hold line is actually composed of two solid (far side) and two dashed lines (near side) for a total width of 3.5 feet. Figure 10 of AC 150/5340-1G, clarifies the distance as being measured from the far side of the hold line. Those hold lines not meeting this measurement usually erred to the conservative side. That is to say the back of the hold line was the required distance plus 3.5 feet from the runway centerline.

Another notable item about the hold lines was that there were two main standards being used for those placed on a taxiway that was skewed to the runway centerline. Under FAA direction, some designs have placed the hold line according to the feature closest to the runway. According to AC 150/5340-1G Table 4, the hold line distance from the runway centerline should be measured at the point where it intersects the taxiway centerline. Those hold lines not meeting this measurement usually erred to the conservative side.

The other dilemma is somewhat more serious and is two pronged but seems to have a more obscure answer. The dilemma involves airports with Non Precision Instrument Approaches (NPI) - more particularly Circling Approaches. Some airports with these conditions had NPI markings and some did not. Some airports only marked the runway end with a straight in approach with NPI markings. Others only had fixed distance markings with aiming points. Per AC 150/5340-1G Figure 2, all NPI runway should be marked with threshold marking and aiming point marking. Visual runways should be marked with aiming points. Most Montana general aviation airports are not marked to these standards. Obviously there is a grey area as to whether or not a circling NPI approach is recognized as an instrument approach.

NPI runways also had a variety of runway lighting types. Some had four lights on each side of centerline for the threshold lighting while others had three. Some had the yellow/white globes on the last portion of the runway while others had only white. This discrepancy is related to the confusion over what defines an instrument runway approach, and whether it includes NPI circling approaches.

This question has been addressed to the FAA's Helena Airports District Office and they are seeking a determination at a higher level.

These two areas confusion point out good cause for conducting this standards review. During the process of evaluating airports according to accepted FAA criteria, inconsistencies in the application of standards were found. Therefore the exercise also resulted in the identification of possible flaws or grey areas in the standards.

CHAPTER 3
RESULTS

CHAPTER 3 RESULTS

3.1 DATA COMPARISON

The results of the Standards Review have been shown in three ways. First, the results are shown in the checklist format, similar to how the information was recorded in the field. The checklist shows a side-by-side comparison of each attribute to recommended characteristics. Again when conformance was plainly evident, it was so noted rather than measured.

Each airport's runway was evaluated based on three general criteria: runway inventory, runway end inventory, and runway lighting.

Runway inventory dealt primarily with standards which are measured relative/parallel to the runway centerline, as well as length, width, and pavement markings. Length was not measured in the field, instead ALP runway length was used for comparison to that recommended by the FAA based on their Airport Design software. Since most airports having pavements sections able to withstand loads greater than 12,500 pounds did not meet recommended runway lengths for large aircraft, small aircraft standards were also included in the footnotes for comparison. Also, airports with crosswind runways include a footnote showing 80% of the primary runways length as recommended by the FAA.

Elevation shots were not taken in the field to determine longitudinal grade acceptability. Instead, visual observations were made; and when conditions warranted, research was conducted through available drawings to determine grade compliance.

The Obstacle Free Zone analysis is somewhat mute because as it is defined, the OFZ will always be in compliance when the OFA is in compliance provided there are no infringements introduced as overhanging obstructions. This is so because the OFZ's dimensions are always smaller than the OFA, and the definition of an infringement is the same.

Runway end inventories included evaluation of the OFA and RSA beyond the runway ends and comparison of actual approach slopes against criteria listed in FAR - Part 77.

Finally, runway edge and threshold lighting were evaluated for spacing between lights and distance from pavement edges. Longitudinal spacing of runway edge lights was determined by spot checks rather than measuring all light spacings. Oftentimes lights would be missing and they were so noted when observed. When two or more lights were damaged or missing, the airport has been noted as non-conforming in that category.

Taxiways were also inventoried for width, RSA and OFA satisfaction, and pavement marking conformance. For taxiways, the distance to a fixed or moveable object was included, although it is a redundant line item. The allowable distance is always one-half of the taxiway's object free area width. As with runways, the lighting or lack thereof was noted for type, condition, color, and placement on each taxiway.

Additionally, the forms show that information was recorded on other miscellaneous items at the airport. The approximate beacon height, if applicable, was noted as determined by the inclinometer. Its type of mounting, the size, and usually the approximate position was also noted.

Approach lighting and indicators were recorded if present. The position relative to the pavement edge, condition as determined by the observer, and manufacturer were normally recorded.

Another item receiving a subjective condition rating was the airport's windcone(s) and segmented circle(s). The construction type of the segmented circles was also noted because of the wide range of styles encountered. Height and position of windcone and segmented circles were noted.

Since fencing was not related to any of the other items being evaluated, little emphasis was placed on determining its condition. When readily observable, the examiner noted fence line condition.

Signage varied widely among the airports, ranging from none to an abundance of directional or informational signs. Most signs were internally lighted. There were a few, however, that were reflective only. The manufactured signs were almost without exception in good condition. Placement relative to the pavement edge was usually adequate, but distance from runway centerline varied because of changing airport dimensional standards.

The second way in which the results are shown are by graphical notes on a schematic drawing of each airport. Separate symbols around each number represent non-conformance items of each runway or taxiway. They correspond to non-standard conditions noted in the checklist forms preceding each drawing. On occasion, additional notes are included for other items of interest. As noted earlier, roads and fences are only shown when they create a non-standard condition or are within the RPZ. Windcones and beacon placement are always shown as are NAVAIDs such as Very High Frequency Omni Range (VOR) equipment or Non-Directional Beacons (NDB). Structures such as weather stations and hangars were not shown on the drawings unless they caused a non-standard condition.

On the drawings, the associated city name was used as a title in the upper right margin and in an upper corner of the drawing portion of the sheet. The reasoning behind this was to facilitate copying to 8-1/2" x 11" paper size. If so desired by future users, the large sheets can be copied one half at a time and still retain a title that can easily be linked to other documents in the report.

The third way in which the results are shown is by use of an overall summary table. This table is included in the report summary in *Chapter 4.*

Following each airport's completed checklist and non-standard condition drawing, there are reproduced photographs of the approach into each runway end. They were included as a tool for helping the readers picture the site, and as documentation of the current conditions at each site. Where approach obstructions or other infringements are visible, they are noted with the photographs.

Admittedly, not all the photographs show much contrast. This attests to the weather conditions experienced during the evaluation. Conditions varied widely from day to day and from site to site. Snow covered ground and twilight hours made photography a challenge. Despite the lack of high contrast, photographs are included for each airport and can be replaced or added to as new photographs are taken.

Each airport was visited by the same person. At times other personnel were present to aid in the collection of data. This contributes to a consistent product for the Montana Aeronautics Division.

3.2 INDIVIDUAL AIRPORT RESULTS

The field checklists, airport schematics with non-standard conditions noted on them, and runway approach photographs for each airport studied as part of this report are included as *Appendix 1*.

The checklist's first column shows required criteria as defined by accepted FAA standards. The next column shows field measurements or a note of obvious conformance. Next is the information from the ALP. The last column indicates either conformance or non-conformance.

CHAPTER 4
SUMMARY

CHAPTER 4: SUMMARY

Table 4, included at the end of this chapter, is a concise compilation of the deficiencies noted at all the airports evaluated. The top row of items in the table corresponds to the items in the far left column of each airport's individual field inspection forms. Any non-conforming or not applicable items noted on those forms have been shown here.

A high degree of consistency has been provided in the way the airports were evaluated since each of the airports was visited by the same person. In addition, the staff involved in putting this report together are very familiar with many of the airports in the State.

4.1 GENERAL OBSERVATIONS

Some general observations can be made about the airports relative to the criteria evaluated as part of this contract:

- ✈ Airports generally had few infractions. The most common items noted as non-conforming were transitional surface penetrations and flush pavement edges. Many of the airports with flush pavement edges showed signs of pavement deterioration at those edges due to water effects and weed growth. Most infractions were relatively minor as they are not tremendous safety concerns to the flying community.

- ✈ Airports in Montana are very accessible. Only four airports were unaccessible (locked gate) to vehicular entrance by the general public. While this is convenient to the flying community, unauthorized access results in a large risk of damage to aircraft on the field, vehicular / aircraft incidents, and vandalism to airport equipment such as lights.

- ✈ Equipment on the airports were, with few exceptions, in good condition but oftentimes fairly weathered. A few airports had runway lighting that was in poor condition as a result of vandalism or inexperienced snow-plowing. Poor plowing techniques also created unsafe transitions from the ground in the runway safety area onto the pavement at the end of the runway at some airports.

- ✈ Only four runways out of the 65 evaluated were substandard in width, and only eight of the runways did not cover at least 75% of the small aircraft fleet with their runway lengths.

- ✈ None of the airports with pavement strengths able to withstand large aircraft had adequate length to support 100% of that aircraft fleet. This is probably due to the fact that there are not enough operations at these airports to justify longer runways. In many cases, physical constraints also make it very difficult, costly or impossible to provide a longer runway.

- ✈ Runway safety area and object free area items of non-conformance were fairly common. On the other hand, FAR - Part 77 surfaces, particularly transitional surfaces, had the most infractions as a whole. These non-conforming items (such as trees, buildings, and windcones) violated the established standards by the greatest amount. The location of these surfaces contributes to these violations, since the areas to the sides of the runways usually receive less attention than those items nearer the approach.

- ✈ Runway grade and site distance are probably the items with the least number of infractions found at the airports. These infractions were generally small in nature.

- ✈ Pavement markings were very often weathered and hard to see. Section 2.3.3 of this report explains in detail an area that should be addressed concerning the marking and lighting of Non-Precision Instrument rated runways.

- ✈ Approach obstructions were very few and in most cases minor.

- ✈ Runway lighting was generally very good with a spotting of vandalism and snowplow damage. Several airports did not have lighted or reflectorized markings along their taxiways or apron edges where taxiing might take place.

- ✈ Finally, taxiways usually had few non-standard conditions that were generally minor in nature. As on the runways, the pavement edges were commonly flush with the adjacent ground. Signage where taxiways intersected runways and at runway / runway intersections was not consistent. A few airports had signs at every intersection, many of the smaller airports had no signage, and some had signs at only the critical junctions. This inconsistency in signage may be a result of the FAA's signing directives which progressed through a series of eleven Signs and Marking Supplements released between 1992 and 1994.

Use of this report, particularly the tables and *Appendix 1,* should provide the Montana Aeronautics Division with a valuable tool for planning and evaluating airport needs to determine priorities on future projects. Airports can be compared to each other to determine which are in the most need or have the worst non-standard conditions.

Perhaps most importantly, when Federally funded projects are started at an airport, this document should be reviewed to make sure as many non-standard conditions as possible can be alleviated at the airport. At a minimum, it can indicate which items at an airport should be accurately measured and placed on the airport's ALP as a non-standard condition.

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APPENDIX 1
INDIVIDUAL FIELD INSPECTION FORMS, SITE SCHEMATICS AND APPROACH PHOTOGRAPHS

SEE INDIVIDUAL PDF FILES FOR

COMPLETED FIELD INSPECTION FORMS

SEE INDIVIDUAL PDF FILES FOR

APPLICABLE AIRPORT SKETCHES

SEE INDIVIDUAL PDF FILES

FOR SCANNED AIRPORT PHOTOS

APPENDIX 2
FIELD INSPECTION FORMS FOR EACH AIRPORT REFERENCE CODE ENCOUNTER